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6. AUTHOR(S)

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13. ABSTRACT (Maximum 200 words)

This report results from a contract tasking Sofia University, Faculty of Physics as follows: The contractor will synthesize improved 125mte samples for use in gamma emission experiments as described in his proposal.

14. SUBJECT TERMS

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FINAL REPORT (SPC 96-4039 (Dr. Kamenov))

Title:

INVESTIGATIONS OF SUBSTANCES OF 125m-Te AND REPETITION OF ALPATOV-DAVIDOV'S EXPERIMENTS.

Author: P. S. Kamenov

An unseparable part of this Report is the "Interim Report" in which the following Plan of works was exposed:

SHORT PLAN OF WORKS

Natural Te:

1. *Preparation of the substance BeTe:* a) with heating of the *mixed 1:1 Be and Te* (like the Russian experiment [2,3]); b) *with mechanic-chemical synthesis in a mill*; (both from natural Te).
2. *Preparation of sources and absorbers for Moessbauer effect.*
3. *Preparation of Moessbauer vibrator for measuring at zero velocity (resonant absorption) and high velocity (not resonant absorption).*
4. *Preparation of a cryostat for liquid Nitrogen.*
5. A Cryostat for temperature of liquid Helium.
6. *A planar detector with efficiency $\varepsilon \approx 0.8$.*
7. *Spectrometric equipment.*
8. Irradiation of the sources with thermal neutrons.
9. Measurements with natural sources: a) with vibration and without vibration; b) with self-absorption at different temperatures.
10. Determination of f_m and calculations of f_s.

Enriched ($\approx$ 95 %) 124-Te:

If the results of measurements are positive, the above equipment and works will be necessary.

For INTERIM REPORT we have completed the following items: 1.b), 2 - 4, 6, 7. *(These items here are in italic)*

FURTHER EXECUTION OF THIS PLAN.

The works were accomplished in France, Center d'Etude Bruyeres Le

19970618 029

Chatel, Physique et Technique Nuclaier.

ITEMS - EXECUTION:

1.a). This is not accomplished, forbidden by the Safety Department because of toxic Be.

All other items are accomplished with BeTe prepared as stated in item 1.b) *(mechanic-chemical synthesis)*. So, a new method for the synthesis of BeTe is checked, different from Russian (Alpatov-Davydov's) method.

2. 10 Mossbauer absorbers with different thickness were prepared from 50 mg/cm^2 to 1 g/cm^2; 3 Mossbauer sources were irradiated for different periods of time: 3, 7 and 20 days.

3. Mossbauer vibrator: Supplied with transformer, 50 Hz, voltage from 0 to 7 V, vibration amplitude from 0 to 2 mm.

4. The Nitrogen cryostat was not used because of item 5.

5. The temperature of the source in the Helium cryostat can be changed from 3° K to room temperature. The great disadvantage of this cryotat was its principle of work - for constant temperature there existed continuous vibrations which are an obstacle for Mossbauer experiments. For these experiments the cryostat was switched cyclically (for maximum 10 minutes, the temperature changes in this time interval were between $2^\circ - 5^\circ$).

6. The energy resolution of our planar detector (for Mossbauer energy, 35 keV) was fine, < 400 eV and for 110 keV < 500 eV.(efficiency for photo effect peak 110 keV, $\varepsilon > 0.8$).

7. The *Spectrometric equipment* was very good for this counting rates, but some improvements for greater counting rates will be necessary (which are inevitable further).

8. The 3 sources were irradiated for 3, 7 and 20 days. The most suitable activity (counting rate - distance) was obtained for 7

days irradiation.

9. Measurements with natural sources: a) with vibration and without vibration; b) with self-absorption at different temperatures.

a) The Mossbauer source was put in the cryostat which has 4 Beryllium windows for radiation. Two of the windows were in direction of the needle (source) axis and two in the perpendicular direction. (The source length (l)$\simeq$ 10 mm and diameter (d)$\simeq$0.8 mm) The Mossbauer absorber was situated in the middle of the distance between source and detector. The maximum admissible mean velocity of the absorber with respect of the source was about 10 cm/s (which is far from the resonance). Our expectation was that when the source is at zero velocity (great resonance absorption), the detector will register small counts in the Mossbauer line (35 keV). When the velocity of the absorber is different from zero, the counts in the Mossbauer line (35 keV) must be greater in comparison with zero velocity.

Several such experiments were performed (in the two directions of the needle) but noticeable change in the counting rates was not observed. This would be possible if the source (BeTe) has the temperature of Debye $\theta < 200^{\circ}$ K and $f_m < 0.3$. The following experiments confirm this conclusion.

b). The self-absorption of the resonance gamma quanta depend on the source temperature. At low temperature (4°K) the Mossbauer factor f_m must be greater than at temperature 300°K.

On the Figure an example of these experiments is shown. Along the abscissa is the temperature of the source and along the ordinate are the relative intensities of the Mosbauer line (without absorber). It is seen that when temperature increases, the intensity of the line increases also (self absorption decreases). From these results one can estimate the Debye temperature (θ) of the substance, BeTe. The experiment shows $\theta < 188^{\circ}$K. The Russian group (and other authors) estimate (for their BeTe), $\theta \simeq 380 - 420^{\circ}$K. This temperature ($\theta$) depends on the physical structure of the substance and we can not identify another reason for such a

value of θ except the method of the synthesis.

10. Determination of f_m and calculations of f_s.
Our estimations are: $f_m \simeq 0.4$ (at $T = 4^\circ K$) and $f_s \simeq 10^{-4}$ (at $T = 4^\circ K$).

Conclusions. These first experiments show that the substance (BeTe), obtained after this mechanic-chemical method, is not sufficiently good for stimulated emission experiments. Perhaps it will be necessary to heat the substance at $T \simeq 1200^\circ$ K and repeat these investigations.

Because of the lack of financing these experiments were suspended.

My experience in this field allows me to make here A PROPOSITION FOR A STIMULATED EMISSION EXPERIMENT, short description of organization of the works and other necessary explanations.

I HAVE NO DOUBT THAT ONLY THIS ORGANIZATION CAN ALLOWS CREATION OF A WORKING GAMMA LASER.

Supplement: A proposition for research project.

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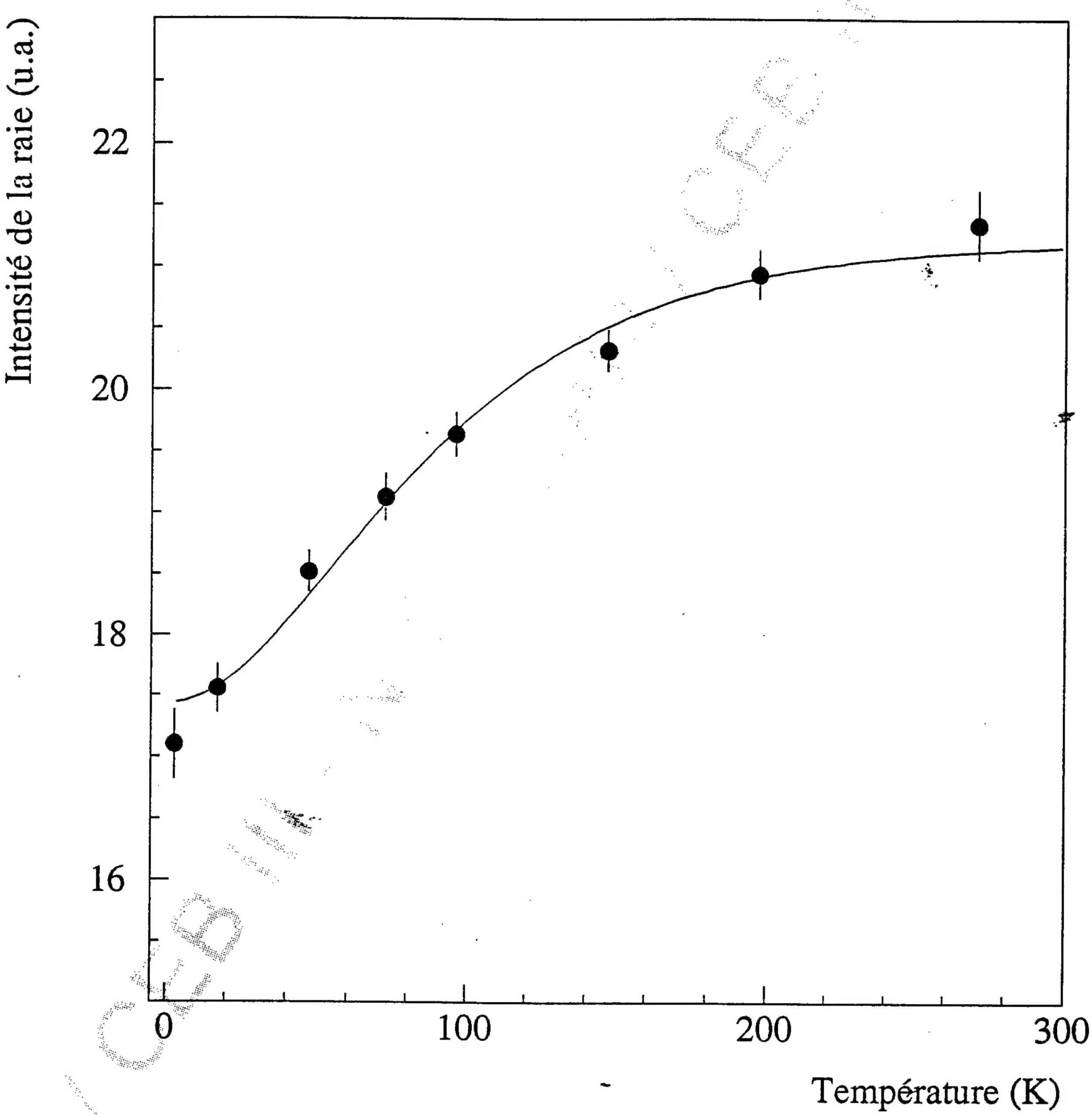

$Q_1 =$

$Q_2 =$

49 %

$\boxed{\Theta = 188 \pm 1 \text{ K}}$